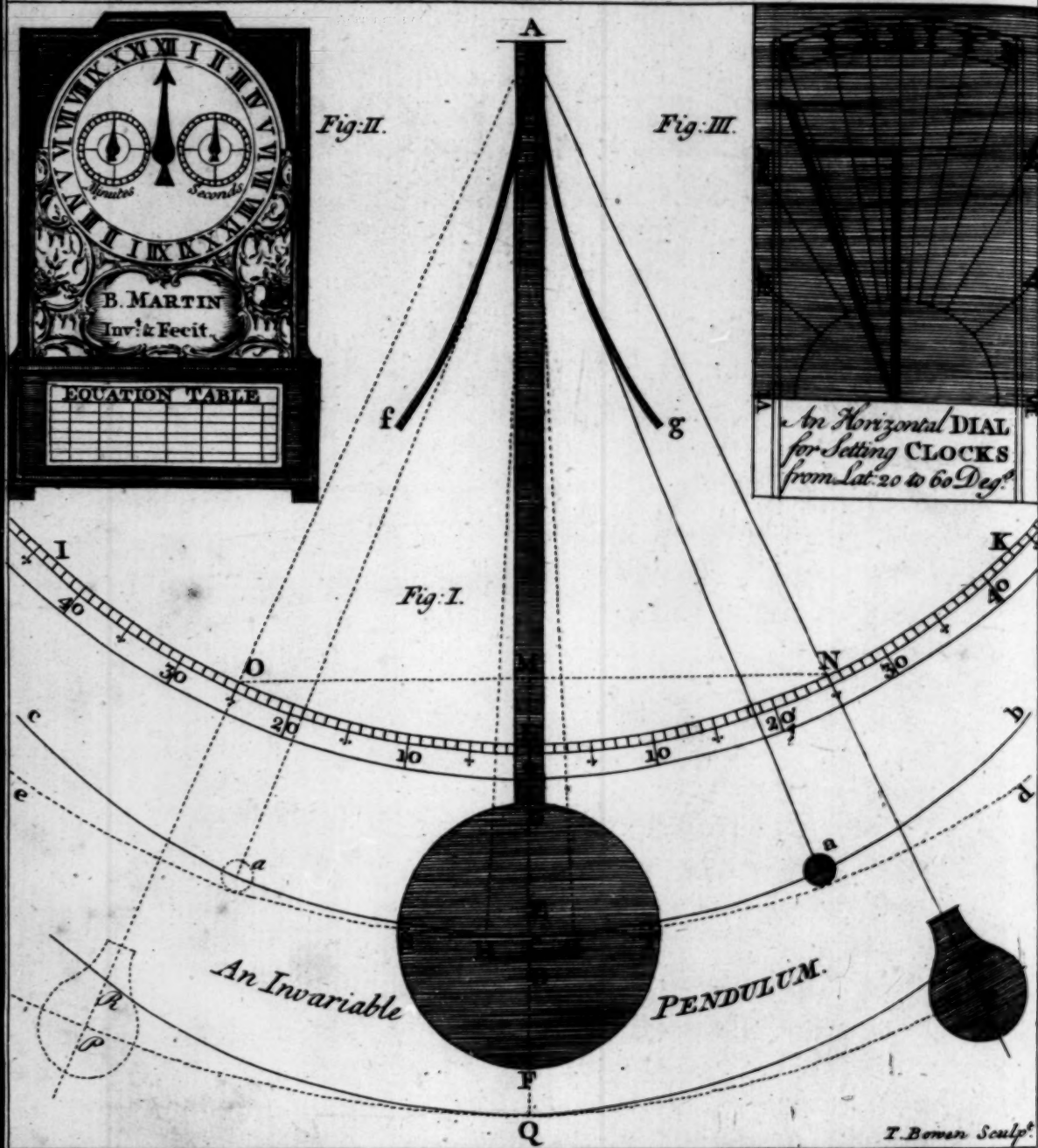


**A TABLE CLOCK on a New CONSTRUCTION; going by a WEIGHT & Days; with a Half-Second PENDULUM, of an Invariable Length, shewing HOURS, MINUTES, & HALF-SECONDS by New & most simple Machinery**  
 Invented made & sold by B. MARTIN. LONDON.



Fig. II.

Fig. III.



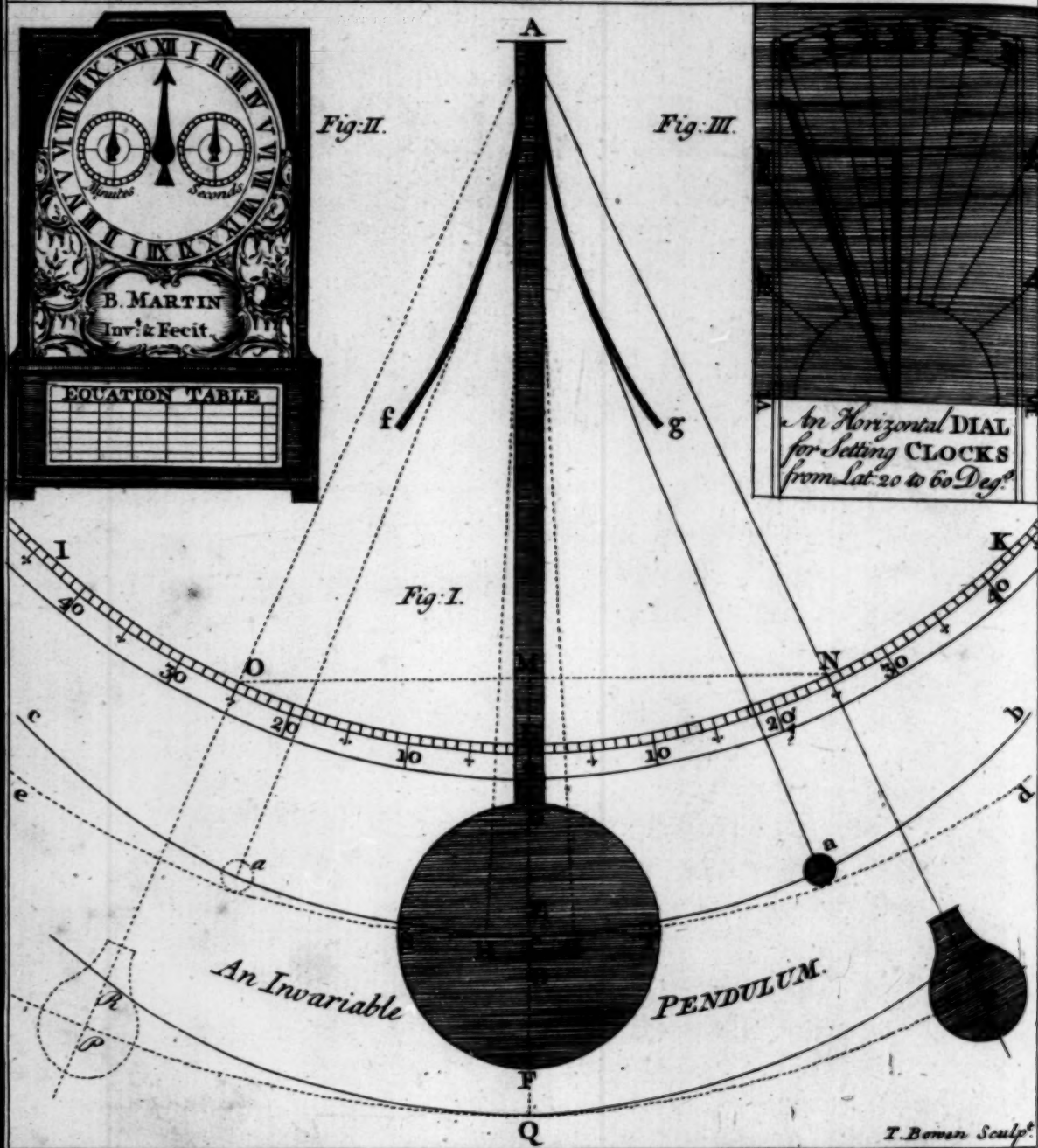
T. Bowen Sculp.

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Fig. II.

Fig. III.



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THE

DESCRIPTION and USE

OF A

# TABLE-CLOCK

UPON A

NEW CONSTRUCTION,

Going by a WEIGHT Eight Days; with a Half-Second PENDULUM of an *invariable* LENGTH, and thereby dividing TIME into HOURS, MINUTES and HALF-SECONDS, with all the Accuracy possible.

WITH

An Account of the particular PRINCIPLES, derived from NATURE and ART, upon which this new MECHANISM depends.

By B. MARTIN. (*Benjamin*)  
K

Invented, made, and sold by the AUTHOR, in Fleet-Street, No. 171.





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T H E  
 D E S C R I P T I O N and U S E  
 O F A  
 T A B L E - C L O C K  
 U P O N A  
 N E W C O N S T R U C T I O N .

**I**T is presumed that every one who pretends to any Skill in Clock-Work, must necessarily know, that all the Truth of such Time-Pieces depends upon, and results from, the three following general PRINCIPLES : (1.) The *equable* and *uniform Tenor* of Force in the *Primum Mobile*, or First Mover, which is either a WEIGHT or a SPRING. (2.) The *free and natural Action* of that part which governs and regulates the Motion in Clocks and Watches, and causes them to divide Time as equably as possible. This is done by a PENDULUM or *Ballance-Wheel*. (3.) The Goodness and Truth of the Work of the Wheels and Pinions in the BODY or TRAIN of the CLOCK.

Now the Reason on which I ground my *new* PLAN or CONSTRUCTION of a TABLE-CLOCK, is owing to the Observations  
 I have

I have long made on the Defects of the common Sort of *Table-Clocks* in every one of the above recited *essential* Particulars. For, in the first Place, every *Clock-Maker* must allow that the Action of a *WEIGHT* is the *only Principle* for generating equable Motion that Nature affords, at least much more so than a *SPRING* and *FUSEE* can be, though it has not been as yet applied to *Table-Clocks*. In the second *Essential*, the *PENDULUM*, I shall be more particular in it's Defects in common Clocks by and by; and shall only say, with Regard to the *TRAIN* of Clocks, as they are usually made, it is very different from that in mine.

In the new Construction of the *Table-Clocks* I here propose, it is necessary then that they should go by a *WEIGHT*; and that this Weight should not exceed what is required to actuate the *Pendulum* in a proper Degree, and accordingly it is adjusted to answer that Purpose adequately.

In the the next Place, the *Train* of *Wheel-Work* in these Clocks is quite of a *new Form*; for, as they shew the Time in *Half-Seconds*, the *Hour*, *Minute*, and *Second Hands* are all upon separate Axles, and independent of each other, there being nothing of that *Intercalary Work* between the *Dial-Plate* and *Body* of the Clock, as in all others; and by this Means the System of *Wheels* and *Pinions* is undoubtedly rendered the most simple and perfect that this Sort of Mechanism will admit of.

Further, a new Calculation for the *Train* in general, and quite a new Form for the *Swing-Wheel* became necessary, inasmuch as this *Wheel* immediately acts upon the *Pendulum*, and not only communicates to it the requisite Impulse, but likewise determines the *Arch* of *Oscillation* or *Vibration*, upon which the *Truth* of *Clock-Work* so much depends.

In order to make this important Article of the *PENDULUM* as plain as may be, I shall here explain it's principal Properties by a Figure in the *Frontispiece*. Let (a) be a heavy Ball, suspended upon the String (A a) from the Axle, or Center A, on which it is supposed to move with the utmost Freedom. Then if this  
Ball

Ball were brought to the Point (a), and there let go, it would descend and vibrate through an Arch (a a), bisected in the Point C by the perpendicular Line A Q.

But this Arch or Extent of Vibration will very sensibly lessen, and in a few Minutes be reduced to the small Arch G H, of about *Half an Inch* in Length, in which the Pendulum will continue to oscillate for a considerable Time, 'till this also gradually decreasing, the Ball or Pendulum will at length be reduced to rest in the lowest Point C.

Now the Pendulum is reduced to rest by the Action or *Resistance* of the *Medium*, Axle, &c. From hence it appears that a Force must be derived from the *Primum Mobile*, or Weight, through the Train of the Clock, and impressed on the Pendulum, that shall be a little superior to the retarding Forces of Resistance, that so the Clock may be constantly kept in Motion.

Since all the Truth of a Clock depends upon an *exact Equality* in the Times of Vibrations of the Pendulum, and these Times can never be equal but when the Pendulum moves in the Arch of that particular Curve (b c), which is called a *Cycloid*, and that must be effected by making the String of the Pendulum apply itself to the two inverted Parts of the same Curve A f, A g, (called *cycloidal Cheeks*) therefore it will follow that no Pendulum, left to itself, *can oscillate in equal Times*; as, in that Case, it must describe the Arch of a Circle (d e.)

But since the Cycloid (b c) and the Circle (d e) do both pass through the Point C; and that therefore they must nearly coincide for a small Space on either Side, as from C to G and H; consequently, if the Pendulum vibrates through a very small Arch G H, of about 3 or 4 Degrees, or  $\frac{1}{4}$  an Inch, it may be deemed as vibrating in the *Cycloid* (b c), and therefore in *equal Times*. Hence the Reason why the Pendulums of these new Clocks oscillate through so small an Arch as  $\frac{1}{4}$  an Inch, or  $\frac{3}{4}$  at most.

B

Whereas



Whereas in the common Clocks the Pendulum P is often observed to swing through an Arch of a Circle P P of 4, 5, and 6 Inches Length; and therefore far enough different from the *Cycloid* R R through the same Point Q. Hence it must be easily seen, how far such Pendulums must be from any Disposition to vibrate in equal Time, and that they never can go true but by Violence and unnatural Methods; for, as I observed, no Pendulum does naturally *vibrate* in a large Arch; the continued large Oscillations of Pendulums, therefore, in common Clocks must proceed from the too great Force or violent Action of the Spring.

It is also well known, that for a Pendulum to vibrate in a *given Time* it must be of a *given Length*: By the Length of the Pendulum is meant the Distance between the *Center of Motion* and of *Oscillation*; but where either of these Centers can be found in the common Pendulums of Clocks, there are no Means to discover. In the Clocks I make, these Centers are truly determined, and consequently the Length of the Pendulum, by *Mathematical Calculation*.

As the Equability and Truth of the Oscillation of Pendulums depend on their Length, it is evident, unless that Length be constant, the equal Motion cannot be so. But *metalline Substances* of every Kind have their *Lengths variable by HEAT and COLD*; consequently the Rods of the Pendulums for these new Clocks *are not to be of Metal*, but of such a Substance as will not sensibly alter in Length by the *most extreme Degrees of Heat and Cold* that any Clock can possibly be exposed to.

Lastly, the Length of a Pendulum, constructed as it ought to be, has also a Relation to the Ratio there is between the *Weight of the Rod A B*, the *Weight of the Bob B S F T*, and the Diameter thereof B F: These are therefore most scrupulously to be attended to, and determined by a *BALLANCE*.

But



But, that the Whole of this *new Plan of Clock-Work* may appear in one Point of View, I have here connected all the *Essentials* as follow: (1.) The Distance A C of the Center of the Ball or Bob C from the Center of Motion A. (2.) The Distance A D, or A E, of the Center of Oscillation D or E, from the Center of Motion A. (3.) The Radius B C of the Bob, which in these Clocks is a *circular Plane* B S F T. (4.) The Weight of the Bob. (5.) The Weight of the Rod. (6.) The Arch or Chord of Vibration G H or N O. (7.) The peculiar Nature and Substance of the Rod. These are all determined with the greatest Precision in these new Clocks; but in the Construction of Clocks in the common Way, there is not the least Regard to the due Quantity of any one of them. In short, all that NATURE, by NUMBER, WEIGHT, and MEASURE can impart to Mechanism, is here applied to the utmost of my Power.

These Clocks go *Eight Days*; and being constructed upon so natural and perfect a Plan, they merit to be regarded as REGULATORS, by which Watches and other less accurate Time-Pieces may be set, and by which the nicest Purposes of *Astronomical and Chronometrical Observations* may be answered, as they may be stopped at so minute and critical a Point of Time as *Half a Second*, which is twice the Exactness of the usual large *Regulators*.

If the Motion of the Clock should at any Time be stopped, by forgetting to wind it up; or otherwise, it may be set by a Dial adjusted by a magnetical Needle, which is also contrived to answer that Purpose in the best Manner, in any Latitude less than 60 Degrees; and to that End I have placed in the Clock a Table of the EQUATION of TIME, rectified to the present Year 1770, and will serve for many Years to come without sensible Error.

For astronomical Uses it should be set by the Altitude, or equal Altitudes of the Sun; and by Observations of the Stars, it may be always made to shew the mean Time correctly, as they  
very

very well know how to effect, who are concerned in these curious Parts of Science, without any Directions from me.

If any Person be desirous of seeing a genuine Demonstration of the Truth of every Thing here advanced, he may be fully satisfied by consulting a Treatise intituled *Institutiones Horologicae*, or *Physico-Mathematical THEORY of CLOCK-WORK*, which was published some Years ago as a Part of my *Mathematical INSTITUTES*, in 3 Vols. 8vo.

And it may be some Satisfaction to the Public to be assured, that I have placed the Rods of these Pendulums upon a PYROMETER, which magnifies the Extension of any Substance 3000 Times; and though placed very nigh to a great Fire there appeared no Motion of the Index, which for Metals would have made several Revolutions with that continued Degree of Heat.

At the same Time I kept them in a Glass Tube in a *freezing Mixture* (of Salt and Snow,) but could perceive no sensible Difference in the Length. The same Rods, taken hot from the Fire, were immediately plunged into Spirits of Wine, and after being thoroughly saturated with the Liquor, discovered no Difference in Length that could affect the nicest Time-Piece whatever.

Therefore, by small Degrees of Heat and Cold, Moisture and Dryness, the Rods of these Pendulums cannot be affected in any sensible Degree, nor be productive of the Errors which are common to those of Metal. And therefore what *Hugenius* observes of his Clock, whose Pendulum oscillated in the Arch of a Cycloid, may with almost equal Truth and Propriety be applied to these, viz. *That such a Clock must either measure Time truly, or not at all.* And I hope it will not be thought presumptuous to affirm, that *These are the first and only Clocks that have been constructed with an INVARIABLE PENDULUM, of a Half-Second Length, and put in Motion by a WEIGHT.*

There

There is indeed an Account of a *Pendulum immutable* in Vol. vii. of the *new* COMMENTARIES of the IMPERIAL ACADEMY OF SCIENCES at PETERSBURGH. But when we are told, that it had a *Steel Rod*; and that it would not perform *accurately* but in *one constant Temperature of Air*, regulated by a Thermometer, we have no Reason to think it could deserve that Title in the least Degree, but just the contrary; for no *metalline* Pendulum was ever yet heard of, that was not of a *mutable* Nature. Besides, this pretended *immutable Pendulum* was not apply'd to a *Clock*, but to a particular *Chronometer*. And therefore, as it is now near Twenty Years since I first shewed and recommended this truly *invariable Pendulum* in my *public* LECTURES, as the only genuine Regulator of Motion in Clocks, I have no Doubt at all but that the ingenuous Part of the Public will allow my Right to the Invention.

Every Purchaser of these new Clocks may be assured that the true and perfect Adjustment of the Pendulum, in regard to it's *due* LENGTH and WEIGHT, is performed *by my own Hands*; and that the greatest Care will be taken that the Work, in every other Part, shall be good. And, what is moreover quite peculiar to this Construction, is, that the Length of the Pendulum being *invariable*, is to be always truly assigned and determined (when required) by a GAUGE.

In the Works of Nature we never fail to admire the most evident Simplicity and Congruity of Parts; and in Works of Art, *the more Simple the Mechanism, the more perfect the Machine* has been an indisputable Maxim, and scarce ever contradicted but in *Clock-Work*; where, to produce the most perfect Time-Piece, we have seen the most complex, and intricate Mechanism employed. But, as the Public has paid pretty well for such absurd Procedures, I hope the new Construction of a Clock here offered them, as it consists of the least Number of Parts to answer such extensive and ac-



curate Purposes, will be favorably received; and no greater Success is desired than what is proportionable to the Merit of the Machine.

Fig. II. is a View of the Face of the Clock; and Fig. III. of an *horizontal DIAL* for setting the Clock by Means of the *Equation Table*; this Dial has *one Requisite* for this Purpose, which is always wanting in common horizontal Dials though ever so large; it is besides applicable to all other Purposes of a portable Dial, and will serve for all Latitudes from 20 to 60 Degrees.

THE END.



## A D V E R T I S E M E N T.

I. *Geographical* CLOCKS, which shew the Motion of the EARTH upon it's Axis, and of it's Axis about the Pole of the Ecliptic once in a Year; whereby all the geographical Phænomena of the terrestrial System, with Regard to the Position of the Earth, Seasons of the Year, Length of Days and Nights, &c. arising from the diurnal and annual Motion of the Earth, are exhibited for every Day, Hour, and Minute throughout the Year, by an artificial Globe kept in constant Motion by the Clock.

II. *Heliostatical* and *Planetary* CLOCKS; which shew the Time corresponding to the Motions of the SUN, MOON, PLANETS, and STARS, by the *peculiar Structure* of a PENDULUM. Also the heavenly Bodies are at any Time rendered apparently at Rest, and the Sun-Beams fixed for *optical Experiments*, by a new Piece of Mechanism for that Purpose.

III. A *horizontal* DIAL for setting Clocks true to a Minute in any Latitude between 20 or 60 Degrees, by a special Circumstance of the Gnomon, and an *Equation-Table*.

At Mr. Martin's Shop may be had, all Kinds of Instruments and Machines used in *Philosophy, Astronomy, Optics, Hydrostatics, Dialling, Surveying, Navigation, Mechanics, &c.* most of them on a new and advantageous Construction, derived immediately from the Theory, and whose Uses are described in particular Treatises to be had with them.

ARTYER TIERM N T

The first of these is the fact that the  
Earth upon which we live is a sphere  
and not a flat surface. This is proved  
by the fact that the sun and moon  
set and rise in the same manner  
everywhere on the globe. It is also  
proved by the fact that ships sailing  
from the coast are seen to disappear  
gradually from the bottom of the hull  
until only the top of the mast is visible.  
The second of these is the fact that  
the stars are seen to revolve around  
the Earth. This is proved by the fact  
that the stars are seen to rise and  
set in the same manner everywhere  
on the globe. It is also proved by  
the fact that the stars are seen to  
change their positions in the sky  
from time to time.



The third of these is the fact that  
the Earth is surrounded by a layer of  
air. This is proved by the fact that  
the air is seen to move from the  
coast to the land and from the land  
to the coast. It is also proved by  
the fact that the air is seen to  
change its temperature from time  
to time. The fourth of these is the  
fact that the Earth is surrounded by  
a layer of water. This is proved by  
the fact that the water is seen to  
move from the land to the sea and  
from the sea to the land. It is also  
proved by the fact that the water is  
seen to change its temperature from  
time to time.